DEC 12 1924

Volume 10 October, 1924 *Number 10*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication in the Paper Industry

Preparation of the Raw Product

PART I

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS IN THE PULP AND PAPER MILLS

A survey and recommendations for the more widely used machinery from the log to the finished product

GENERAL CONDITIONS

A—Gears, chains, sprockets, wire rope, conveyors, and caterpillar Tractor, link pins and rollers		Texaco Crater Compound No. 1 or No. 2 (Applied hot with brush)
	If water splashed	Texaco Crater Compound X
B—Ball and Roller Bearings;	*Oil tight cases*	Texaco Texol B
	Cases not oil tight	Texaco Liquid Greases or Texaco Star Grease No. 1
C—Grease cups or nipples		Texaco Grease No. 1 or No. 3
	Heat conditions	Texaco Marfak Compound
D—Grease packed plain bearings;		
1.	*Low or medium temperatures and pressures*	Texaco Grease No. 3
2.	*High temperatures and pressures*	Texaco Hytex Grease No. 5
	Drip proof bearings	Texaco Marfak Compound
3.	*If water splashed*	Texaco Star or Hytex Grease

TIMBER OPERATIONS

STEAM CYLINDER LUBRICATION

Steam Donkey Engines, Steam Hoists and Skidders, Steam Tractors, Steam Whirley, Steam Cranes, Steam Shovels, Steam Road Building Equipment	*Dry Steam or Saturated Steam over 150 lbs.*	Texaco 650 T Cylinder Oil or Texaco Leader Cylinder Oil
	Saturated Steam, 100-150 lbs.	Texaco Pinnacle Cylinder Oil
	Wet Steam	Texaco Draco Cylinder Oil or Texaco Olympian Cylinder Oil
Steam Geared Locomotives	*Super Heat Steam*	Texaco No. 635 Valve Oil or Texaco, 650 T. Cylinder Oil
Steam Slide Rod Locomotives	*Saturated Steam over 150 lbs.*	Texaco Railroad Valve Oil or Texaco Pinnacle Cylinder Oil

BEARINGS AND OTHER MOVING PARTS OF PRIME MOVERS	*Close Fitting Bearings Lubricated by Automatic Oiling Devices*	*Worn or Loose Bearings Automatically Lubricated or Hand Oiled Bearings*
Miscellaneous Engine Parts	Texaco Texol D or Texaco Altair Oil	Texaco Texol X or Texaco Pelican Oil
Miscellaneous Machine Bearings	Texaco Texol C or Texaco Aleph Oil	Texaco Texol D Texaco Altair Oil
Miscellaneous Machine Slides	Texaco Texol D or Texaco Altair Oil	Texaco Texol X or Texaco Pelican Oil
High Pressures	Texaco Liquid Grease D or Star Grease No. 00	Texaco Liquid Grease D or Star Grease No. 00
Journal Boxes	Texaco Car Oils Texaco Black Oils	Texaco Car Oils Texaco Black Oils
	Air Temperatures Below 10° F.	*Air Temperatures Above 10° F.*
Gasoline or Kerosene Tractors	Texaco Motor Oil, Heavy	Texaco Tractoil (Proper Grade)
Trucks	Texaco Motor Oil, Medium	TexacoMotorOil(ProperGrade)
Gasoline Hoists	Texaco Motor Oil, Medium	Texaco Motor Oil Heavy or, Extra Heavy

SAW MILL AND WOOD ROOM

	Close Fitting Bearings Lubricated by Automatic Oiling Devices	*Worn or Loose Bearings Automatically Lubricated or Hand Oiled Bearings*
SAW MILL		
Jack Ladders, Log Conveyors, Log Stackers	Texaco Texol C or Texaco Aleph oil	Texaco Texol X or Texaco Pelican Oil or Texaco Dolphin Oil
Slasher and Swing Saws	Texaco Texol B or Texaco Nabob Oil	Texaco Texol D or Texaco Altair Oil
Live Rolls, Kickers and Niggers	Texaco Texol X or Texaco Pelican Oil	Texaco Thuban Compound or Texaco Crater Compound No.1
Steam Cylinders	Texaco Pinnacle Cylinder Oil	
WOOD ROOM		
Drum Barkers	Texaco Texol C or Texaco Aleph Oil	Texaco Dolphin Oil
Disc Barkers	Texaco Texol B or Texaco Nabob Oil	Texaco Texol D or Texaco Altair Oil

**When too heavy for Wick or Ring Oilers, use Texaco Texol X.

	Close Fitting Bearings Lubricated by Automatic Oiling Devices	*Worn or Loose Bearings Automatically Lubricated or Hand Oiled Bearings*
Splitters		
Bearings	Texaco Texol B or Texaco Nabob Oil	Texaco Texol C or Texaco Aleph Oil
Guides	Texaco Texol X or Texaco Pelican Oil	Texaco Cylinder Oils
Chippers	Texaco Texol D or Texaco Altair Oil	Texaco Cylinder Oils**
Horizontal Chip Screen	Texaco Texol B or Texaco Nabob Oil	Texaco Texol D or Texaco Altair Oil
Rotary Chip Screen, Chip Belt Conveyor	Texaco Texol C or Texaco Aleph Oil	Texaco Texol E or Texaco Altair Oil
Chip Crushers	Texaco Texol C or Texaco Aleph Oil	Texaco Texol X or Texaco Pelican Oil
Re-Chippers	Texaco Texol D or Texaco Altair Oil	Texaco Cylinder Oils**

***When too heavy for Wick or Ring Oilers, use Texaco Draco Cylinder Oil.

LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published Monthly by

The Texas Company, 17 Battery Place, New York City

Copyright 1924, by The Texas Company

Vol. X — October, 1924 — No. 10

Change of Address: In reporting change of address kindly give both old and new addresses.

While the contents of LUBRICATION are copyrighted, other publications will be granted permission to reprint on request, provided article is quoted exactly and credit given to THE TEXAS COMPANY."

Lubrication in the Paper Industry

PART 1

Preparation of the Raw Product

WHAT is your lubrication cost per ton of finished paper?

Is your cost higher than the low standard?

Or still more important, are you higher than an established *average*?

What are these averages?

The answer to these questions is the "handwriting on the wall" to the progressive paper manufacturer. Everyone knows that low manufacturing costs, maximum production and minimum cost of maintenance and repair are proportional to scientific lubrication.

But do you know in dollars and cents what goal is attainable as a result of scientific lubrication?

For your reference and comparison, average and low lubrication costs are given in Figs. 1 and 2; actual costs in a typical mill before and after establishment of scientific lubrication in Fig. 3; and average and low maintenance costs in paper mills in Fig. 4.

COST OF LUBRICANTS
PER TON OF FINISHED PRODUCT
U. S. AND CANADA COMBINED, 1923

	Not Including Pulp			*Including Pulp*
	Low	*High*	*Average*	*Average*
News Print Paper	$.06	.27	.12	.15
Paper Board	.05	.24	08	.11
All other Papers	.11	.80	.32	.35
All Papers	—	—	.263	.293

Fig. 1.

COST OF LUBRICANTS
CONSUMED IN MANUFACTURE OF PULP
U. S. AND CANADA COMBINED, 1923

	Per Ton of Pulp Average	*Per ton of Finished Paper Average*
Ground Wood Pulp	.028	.022
Sulphite; Sulphate or Soda Pulp	.047	.008
Paper Stock	....	.030

Fig. 2.

The cost of lubricants per ton of finished paper ranges, amazing as it may seem, from $.06 to $.80 and more. This includes lubricants consumed for machine rooms, paper stock preparation, and power, but not for pulp.

Lubrication of ground wood pulp adds about $.022 to cost per ton of finished paper, and if chemical pulp is also manufactured there is an average additional cost of $.008 per ton of finished paper.

The lowest costs shown above should be considered an attainable goal. Unless your costs are well below the average, you are standing an unnecessary loss, and eating a hole in your profits, which may amount to several thousand dollars annually. In that case an investigation into causes and remedies will pay dividends.

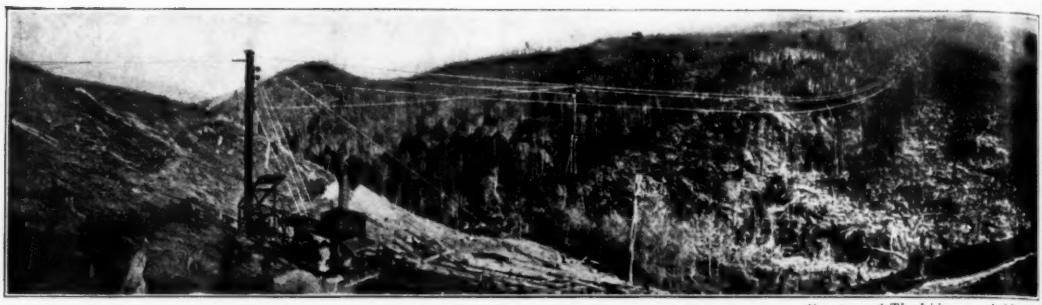


Fig. 5.—Steam hoist and aerial cableway for transporting logs. *Courtesy of The Lidgerwood Mfg. C*

One newsprint mill in Canada saved $11,900.00 in twelve months by following substantially the procedure given below.

In 1922 their lubrication cost for the entire mill was $.29 per ton finished product. A lubrication engineer was consulted, the suitability of the grades of oils used was checked, and an employe was appointed to the one task of minimizing waste. The equipment was modern and fitted largely with automatic oiling systems, which were carefully studied, resulting in several changes. As a result the lubrication cost for power, pulp manufacture and stock preparation was cut from $.06 to $.04 per ton finished paper. In turn the cost for the machine rooms was cut from $.23 to $.11 per ton or a combined cost of $.15 to which must be added the wages of the employe delegated to this work, bringing the total for the entire mill to $.167 per ton of finished paper. While even this cost is higher than the average, it is largely because lubricants in Canada are more costly than in the United States. These costs are tabulated in Figure 3.

COST OF LUBRICANTS

PER TON FINISHED NEWS PRINT PAPER IN A MODERN CANADIAN MILL BEFORE AND AFTER ADOPTION OF SCIENTIFIC LUBRICATION METHODS

	1922	*1923*
Pulp, Power and Stock	$.06	$.04
Machine Rooms	.23	.11
Salary of Oil Man	....	.017
Total for Mill	.29	.167
Saving 1923 over 1922	....	$11,900.00

Fig. 3.

Now refer to Figure 4. How do *your* maintenance and repair costs compare with this data?

Do you realize that $6,000 per year can be saved, in a book paper mill of 10,000 tons annual production, if the maintenance and repair costs are reduced but 20% below the *average?*

And that the actual *low* figures in this table are 70% below the *average?*

The *low* figures are due to practically perfect lubrication.

But, so far we have considered reducing costs only 20% below the average and not down to *lowest* actual figures, therefore if your costs are *above* the *average*, isn't the inference obvious?

In Fig. 4 are shown maintenance and repair costs given by Witham.* While these *averages* $2.30 per ton in 1915 for news print paper and $2.99 in 1916 for book paper yet some reported mills in 1922 operated at less than a dollar per ton.

COST PER TON FINISHED PAPER FOR MAINTENANCE AND REPAIR IN 46 NEWS PRINT MILLS IN THE UNITED STATES AND CANADA AND IN 39 BOOK PAPER MILLS IN UNITED STATES

	1915	*1916*	*1922*
	News Print Paper Mills Average	*Book Paper Mills Average*	*News Print Lowest Reported*
Felts	.73	....	.48
Wires	.38	....	.24
Belting	.09	....	.06
Lubricants	.08	....	.06
Total Maintenance	1.28	$1.43	.84
Repairs	1.02	1.56	.07
TOTAL	2.30	2.99	.91

Fig. 4.

Other Economies from Scientific Lubrication

Of vastly more importance in dollars and cents, than the savings in oil costs and maintenance costs are the other results of scientific lubrication not ordinarily kept track of, for instance: Lower depreciation rate, higher output and lower production cost from fewer shutdowns (a break costs a cent per second at 500 feet per minute), lower power consumption and slower bearing wear. Worn bearings promote oil waste and messy conditions which tend to lower the morale of your men.

HOW TO REDUCE COSTS

Therefore if your lubrication or maintenance costs per ton of paper seem high in comparison with the *lowest* of the above figures, we suggest the following inexpensive procedure which has paid dividends in several instances.

1. *Stop Waste.* One man should be appointed to personally and continu-

*G. S. Witham, "Modern Pulp and Paper Making" (Chem. Catalog Co., N. Y. C.).

ously supervise application of lubricants. In large mills this will occupy his entire time. He may save his salary several times over.

2. *Install inexpensive automatic Oilers.**
   (a) On hand oiled bearings when possible. Hand application of oil or grease is usually inefficient, and in the hands of many operators, hopelessly wasteful. Further, automatic oilers do not depend on a man's memory. They are attended to in regular routine once per week. If you still feel that the human element is sufficiently reliable for safe daily application, consider how much more quickly the inaccessible bearings wear out on the back side of the dryers, and how soon the rolls sag down at the back.
   (b) On plain bearings now lubricated by hand application of grease. Some of the grease bearing boxes of recent design are very efficient indeed. But many are wasteful and messy. About eight pounds of grease are required to do the work of one gallon of oil and oil costs about one-third its equivalent in grease.

3. Verify that lubricants of specifications correct for each bearing and of the requisite quality are in use.

4. This is a day of specialization. A lubrication engineer from a reliable oil company is skilled in this subject and he can assist you to profit by adoption of proved best methods.

Courtesy of The Lidgerwood Mfg. Co.

Fig. 6.—Steel spar skidder with boom loader.

News Print vs. Other Papers

It is not to be expected, however, that the low lubrication cost of $.06 per ton given above for News Print Paper, is to be attained in the manufacture of other papers. High speed machines and quantity production account partly for the lower cost of lubricants per ton of News Print Paper. Furthermore, usually only new machines of recent design can operate at high speed and these are customarily lubricated with oil in economical automatic systems. There is a tendency, too, when newsprint machines become partly worn out and consequently slower, to use them for manufacture of higher grade papers which must be run with more care. Incidentally it is advanced that fast made paper operates with fewer breaks on the fastest newspaper presses running about 2,000 feet per minute. Some paper machines make a sheet 146 inches wide at 1,000 feet per minute, although designed for 1,400 feet per minute. In fact the trend seems to be for a greater width of 220 inches wide and slower speed of 750 feet per minute.

Courtesy of Mt. Murray Woodlands Corp.

Fig. 7.—Caterpillar gasoline Tractor hauling over snow.

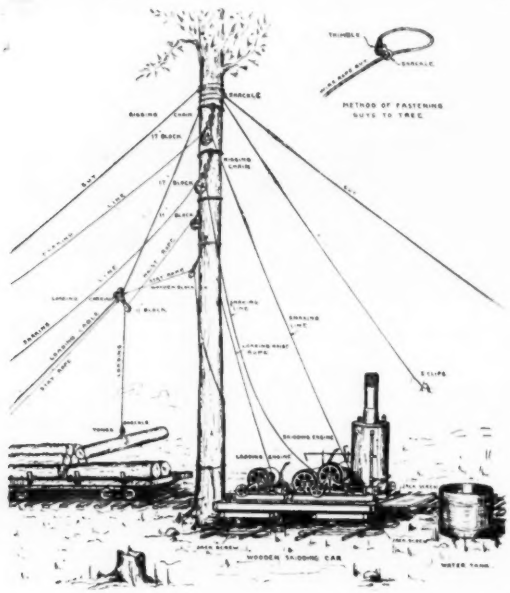
HOW PAPER IS MADE

Paper, no longer a luxury, is now a necessity from the informative newspaper to the dollar bill. The spread of civilization and knowledge generally laid at the door of the printing press would have been impossible without paper. In fact paper began to supersede vellum in the second half of the 14th Century. It was made by hand somewhat as first developed by the Chinese in the 2nd Century B. C., until 1798 when a paper machine was invented by Louis Robert in France. It was improved to a fair degree of success in 1803 by Henry Fourdrinier and Bryan Donkin.

Paper is made by felting or interlacing together minute vegetable fibres. Although most people have a vague idea of the method of manufacture, in theory it is quite simple. The fibres are first finely divided and cut to maximum lengths of about 2.5 mm. (1/10 inch), and then thoroughly mixed with water until a condition of complete hydration or saturation is secured resulting in a mass called pulp. After thinning with water to a soupy

*See LUBRICATION for April, 1924.

consistency it is deposited on a wire mesh screen which is usually given a lateral shaking motion to interlace the fibres while the excess water drains through the screen, leaving the pulp matted together in the form of a mushy



Courtesy of The Lidgerwood Mfg. Co.
Fig. 8.—The "modus operandi" of skidding and loading.

paper. In the hand process this was pressed and dried, sheet by sheet, a process taking about a week.

The Fourdrinier paper machine which has supplanted this, is a huge affair, some being 20 feet wide, 30 feet high and two hundred feet long. The pulp and water mixture flows on the machine at one end onto a rapidly moving endless belt of fine wire cloth. As the wire screen travels along the machine it is shaken from side to side simultaneously interlacing the fibres and draining much of the water which is further removed by passing over suction boxes. The wire with its mushy paper then passes through "couch" rolls which remove sufficient remaining water to give strength enough to the pulp web to permit its transfer from the wire to a felt belt which supports it in its path through the press rolls. These are massive wringers from which it is transferred to another endless felt belt threaded through a long series of huge revolving cast iron steam heated cylinders or dryers, until it emerges as a sheet of dry paper. From there it is squeezed through heavy calendars or ironing rolls to give smooth finish before being wound on reels for shipment.

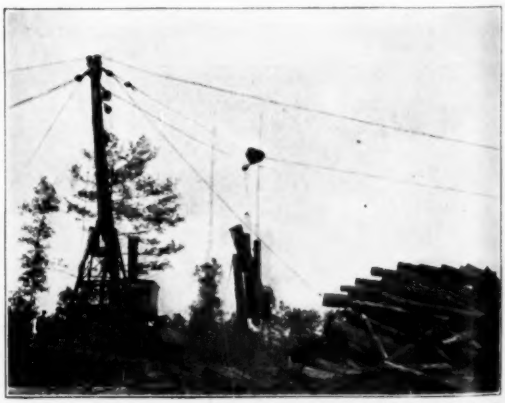
The vegetable product used in all paper pulp, chemically known as cellulose, is the woody fibre forming the principal ingredient of the cell membranes of all plants. It is composed of carbon, hydrogen and oxygen in the same proportions regardless of the source, with a formula $(C_{12}H_{20}O_{10})x$; possibly, $C_{72}H_{120}O_{60}$.

Paper pulp is made chiefly from wood but also from straw, esparto (a grass growing in Spain and Africa), bamboo, vegetable rags, waste paper, etc. Only the highest grade tough papers are, however, ordinarily made from rags.

If the present strain on our wood sources increases or if reforestation should be inadequate there are unlimited sources of bamboo which can be utilized. Bamboo grows so quickly that it is no exaggeration to say that a tract of 16 square miles could *indefinitely* supply a mill with a paper output of 200,000 pounds per day. Bamboo has not been exploited both because of remoteness of source and certain physical conditions of manufacture which only recently have been conquered.

Cotton rags produce a splendid fibre which require very little treatment to adapt it for pulp. That is due to its derivation from what is known as seed hairs, which are almost pure cellulose with a minimum of encrusting and intercellular matter and requires only the removal by steam of some fatty, nitrogenous and coloring compounds. This is practically the case also with the bast fibres present in flax or linen rags.

In America most paper is made from wood pulp. Unless wood is expensively chemically treated to remove the glutinous, resinous and other intercellular matters the pulp will be



Courtesy of The Lidgerwood Mfg. Co.
Fig. 9.—Tailspar overhead skidder with Guy line loader.

dark in color. Therefore newsprint and cheap papers are made from pulp produced by simply pressing blocks of wood against a coarse grindstone. Unfortunately much of the fibres of this ground wood pulp is so short that

admixture of some chemical fibre is necessary for strength.

Chemical pulp is made by subjecting chipped wood to the action of either bisulphite of lime liquor, caustic soda or sodium sulphate and sodium sulphide liquor, at high temperature and pressure. The resulting pulp is known respectively as "sulphite", "soda" or "sulphate," the treatment depending on nature of encrusting material to be removed. There is another process known as the "Kraft," which according to the practice today does not differ materially from the "sulphate." "Sulphite" pulp can be bleached to a snowy whiteness, and is used for bond, writing and high-grade book papers. Bleached soda pulp produces a soft textured book, magazine and envelope paper. Unbleached soda, sulphate and Kraft is usually employed for wrapping and papers where strength but not whiteness is essential.

PULPWOOD PRODUCTION

Logging Operations

Timber is usually felled by means of the two man cross cut saw. Steam and gasoline tractors are displacing horses in the next step of dragging the logs over snow and ice to a temporary spur of the logging railroad, or to the water course for transportation to the pulp mill. Logs can be effectively moved a great distance over rough ground by aerial cable ways operated by steam and gasoline hoists. The logs are loaded onto lumber cars by the steam skidder which also is equipped to haul

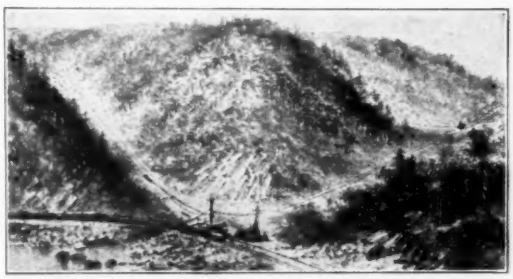
Courtesy of The Lidgerwood Mfg. Co.

Fig. 10.—Overhead Tree Rig Cableway Steam Skidder.

in logs from an area a half mile wide on both sides of the railroad. The skidder is mounted on a heavy flat car with vertical boilers and reversible or link motion reversing engines. Slide rod and geared locomotives, steam snow plows and locomotive cranes also are extensively used in transportation to the mill.

Steam Cylinder Lubrication

In a logging camp it is impractical to use or stock more than one or two grades of steam cylinder oil. Therefore a lubricant capable of meeting a wide range of conditions satisfactorily is necessary. Great care should be exercised in selecting a suitable grade as



Courtesy of The Lidgerwood Mfg. Co.

Fig. 11.—Yarding and Roading on Steep Slopes and Narrow Valleys.

lubrication conditions are severe and vary considerably. Particular difficulty is often experienced due to uncertain feed water giving wet and dirty steam by slugs of water passing to the engine also foaming and priming. For this and several other reasons it is desirable to use a high compound cylinder oil containing from 6 to 10% suitable fatty oil with a viscosity about 130 seconds viscosity Saybolt at 210° F.

Lubrication of Bearings and other Moving Parts of Prime Movers

Miscellaneous engine parts, machine slides and bearings if provided with close fitting bearings and bottle or other automatic oilers should be lubricated by a straight run oil with viscosity of about 300 seconds at 100° F., while if the bearings are worn or loose or hand oiled, an oil with a viscosity as high as 750 seconds Saybolt at 100° F. may be required.

Lubrication of Internal Combustion Engines

When selecting a tractor or motor oil for a gasoline or kerosene engine in a lumber camp, the weather temperatures encountered are of greatest importance. No one thing shortens the life of an internal combustion engine more than the use of an oil which will not flow freely at a cold start. Furthermore, even with the proper oil racing a cold engine to warm it is bad practice. There are many other factors governing the choice of a suitable grade and a chart should be consulted recommending specific grades for each engine as published by representative oil companies and engine manu-

facturers. Even then proper attention to low temperatures found in logging in northern winter climate is often overlooked. If the temperature is below frost but above 10° F. an oil with a viscosity of from 55 to 75 seconds

Courtesy of Mt. Murray Woodlands Corp.

Fig. 12.—Log Pond and Steam Whirley for unloading Boats.

Saybolt at 210° will usually satisfy most conditions met by tractors, trucks and hoists. But if the temperature often goes *below* 10° F., a straight run motor oil with at least a 0° F. cold test and a viscosity from 45 to 48 seconds at 210° F. should be used on trucks and hoists and 52 to 57 seconds at 210° F. for tractors.

Tractors are discussed in LUBRICATION for February, 1924. Recommendations for trucks will be forwarded on request.*

Gears, Chains and Wire Rope

Lubrication

Exposed gears, wire rope, and caterpillar tractor link pins and rollers, if subjected to snow, ice or water conditions, are difficult to lubricate, unless an oil with the necessary characteristics is selected. Excessive wear, rust and power consumption result if scientific lubrication of this equipment is neglected. The problem can be successfully solved by the hot application with a paddle or brush on clean dry gears of an adhesive straight run mineral oil with viscosity of about 1000 seconds at 210° F.

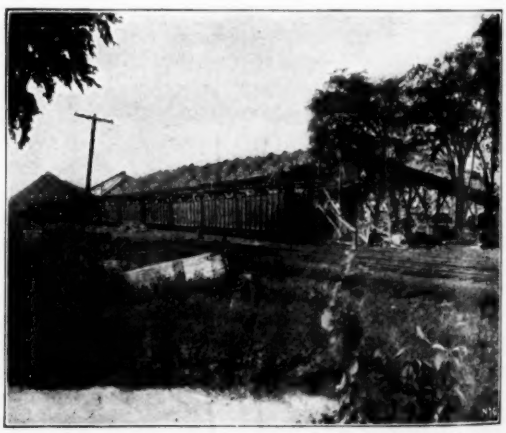
When it cools it leaves a heavy non fluid film on the gear teeth which is almost impervious to action of ice and remains in position under severe pressures. The same lubricant can be used to great advantage to lengthen the life of wire cables. A moment's thought will show that the individual strands move on one another when in use, causing rapid wear unless contact between the strands is prevented by the presence of a lubricant. Furthermore, the ice and water conditions met with, cause considerable internal rust which acts as an abrasive in addition to fine dirt particles carried in with the ice. These troubles can be minimized to a surprising degree and the wire rope will last years instead of months, if it is periodically run through a trough of the above described lubricant heated to a thin fluidity. This permeates the strands and on cooling leaves a firm lasting cushion of non fluid oil throughout the strands, which will repell further entrance of water or ice. Rusting of chains can be prevented in the same way.

*Also, see Texaco Lubrication Guide.

LOG POND TO SAW MILL

The next step in the transformation of pulpwood to wood pulp is the conveying of the logs from the log pond to the saw mill for cutting to uniform lengths preparatory to removing the bark. The logs are then either chipped for digesting for chemical pulp or pulverized against a coarse grindstone for mechanical pulp.

The Jack Ladder is an endless chain conveyor which travels from beneath the surface of the log pond up to the saw room. It is equipped with spikes or dogs which grip the floating logs and is driven by a powerful reduction gear carrying a sprocket wheel. These gears, as well as the sprockets and chains, while operating at low speed, actually undergo severe duty on account of continuous running. Also the continual dripping in water both makes it difficult to keep lubricants in place and promotes wear from metal



Courtesy of Mt. Murray Woodlands Corp.

Fig. 13.—Jack Ladder Conveyor from Log Pond with stacker in background.

to metal contact and causes corrosion and rusting.

Lubrication.

The only lubrication which will stand up under these conditions is the hot application

of the viscous lubricant described above for gears and wire cables in the logging camp.

The conveyor bearings are too often lubricated by hand oiling. In this case an oil of a viscosity not less than 650 seconds at 100° F. should be used and even this must be frequently renewed. If they are lubricated with grease, well and good, providing they remain cool. A medium grease of good quality will answer provided it is made to withstand the water conditions. Wick feed cups would pay their cost in saved oil, let alone reduced wear and saving of labor and cutting out of the uncertainty of the human element. The sprocket gears under water at lower end of conveyor are usually lubricated by water and while at the slow speeds water lubricates and prevents undue wear, there is considerable corrosion and relatively short life, unless provided with compression grease cups.

SLASHERS AND SWING SAWS

The Jack Ladder delivers the logs onto an almost horizontal conveyor which presents them one by one crosswise to the action of several parallel slasher saws which cut them into equal lengths. Another conveyor carries the wood blocks either to storage piles, to the wood room where they enter the barkers or to a railroad car for shipment. Some slasher saws operate at 650 R. P. M. for the saw arbor, giving a rim speed of 10,000 feet per minute.

Logs which vary considerably in length especially if too long for slasher table, are most conveniently cut by a swing saw which can be swung into the position best adapted for each individual log. Long logs are usually conveyed end to end and rolled into crosswise position for the saw by means of a steam kicker and live rolls.

Lubrication

Lubrication of saw mandrel bearings is rarely neglected as is the case with many bearings operated at lower speeds. Nevertheless hand oiling of plain bearings is not at all satisfactory unless frequently attended to, which at the best is wasteful of labor as well as of oil. The operator almost always applies too much at a time in hopes of lengthening the interval until he must attend to it again. This excess is, of course, wasted. A wick feed cup would render lubrication automatic and sure for much longer periods.

If bearings are hand lubricated an oil of about 500 seconds viscosity at 100° F. should be used—the slight loss of power resulting will be compensated for by lower oil consumption. If they are ring or wick oiled an oil of a viscosity as low as 200 seconds will be best unless the bearings are loose when a slightly heavier oil is preferable. Grease cups require a grease of medium consistency.

CONVEYORS

The pulpwood storage pile must be large enough at the end of the fall to last through the winter as the logpond and water course leading to it by freezing over stops this operation. For that reason, during the summer the saws and conveyors keep going day and night at many pulp mills. There are conveyors also from the pulpwood pile to the barkers.

Fig. 14.—Barking Drum. Note chain conveyors in foreground.

Lubrication.

Although conveyor lubrication conditions are severe due to continuous running they operate so slowly that they often receive no lubrication other than shaft bearings and bearings of the rollers which usually are provided with grease cups. This equipment would have a longer life if the gears, sprocket teeth and chains were brushed with a hot adhesive lubricant as described above under gears and chains. When the pulley sprocket wheel and drive shaft bearings are ring or wick oiled, and close fitting an oil about 300 seconds viscosity at 100° F. is suitable. If the bearings are worn or loose or hand oiled, an oil of 650 seconds viscosity at 100° F. should be used.

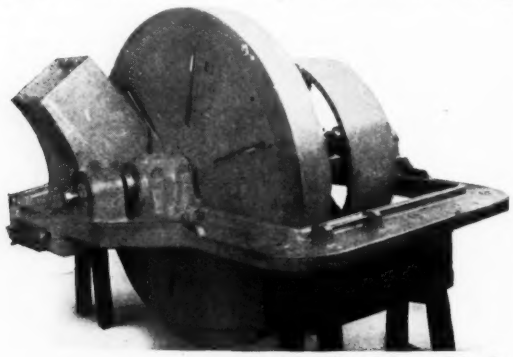
This oil should be compounded to meet water conditions whenever the bearings are subjected to severe splashing from wet logs.

BARKERS

The Tumbling Drums are huge horizontal cylindrical cages which slowly revolve, causing the pulpwood which is fed in one end to fall one on top of another and rub sides with one another, while being sprayed with water. The result is that when the logs reach the other end they are usually perfectly barked. The action is assisted by a series of longitudinal steel bars fastened to the inner walls

—these in effect offer a series of elbows, or dull knives.

The drum barker is usually supported on rollers and operated by means of a pinion and girth gear. Some, however, are driven by a chain passing around the cage and over sprocket wheels. Others do away with rollers being



Courtesy of Rice, Barton & Fales, Inc.
Fig. 15.—A chipper, capable of cutting slices across grain of 12" log.

supported on endless chains passing over sprockets on the frame above

Lubrication.

Only the bearings of the supporting rollers are designed, strange as it may seem, to prevent water flowing over it. They are satisfactorily lubricated with a medium consistency grease. The shaft operating the pinion lies parallel to the drum, and its bearings are rarely designed to prevent the washing action of water continually flowing from the barker. These bearings are usually hand oiled and packed with waste as a means of holding the oil which should be compounded to serve under water conditions with a viscosity of 650 seconds Saybolt at 100° F.; this condition could be improved with wick oilers and an oil of viscosity of about 300 seconds at 100° F. The gears, sprockets and chains should have hot application of adhesive straight mineral lubricant. With all the improper lubrication of these bearings very little trouble actually results on account of being both cooled and lubricated by constant water splashing.

Another common form of barker consists of a large revolving disc set with knives like a carpenter's plane against which the logs to be barked are pressed. The bearings are often provided with an automatic oiling device such as ring, chain or collar oiled type, and if they are plain type wick feed cups can also be adapted. The lubricant should be 200 seconds at 100° F.; a heavier oil, about 500 seconds at 100° F., should be used if hand oiled; and if grease cups or grease is packed in the housing, a medium body should be used.

SPLITTERS

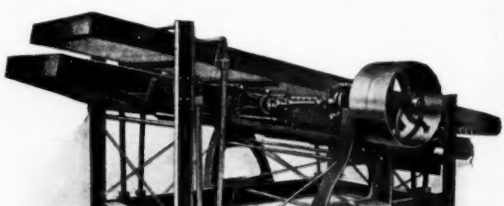
When the blocks are too large for entrance into the chipper spout they are divided by means of the splitter of which there are two types, vertical and horizontal. The splitter is a framework with a heavy mechanically driven axe blade or wedge block. Smaller ones are also adapted for handling so called "last blocks" or smaller lengths for purpose of keeping wastage at a minimum.

Lubrication.

Splitters are not difficult to lubricate, a medium grease packed in the housing being very satisfactory. If hand oiled an oil of viscosity of 300 seconds should be used and if fitted with automatic oiler a viscosity of 200 seconds will serve. The guides if snug or in winter should be lubricated with an oil of viscosity of from 680 to 780 seconds at 100° F.; if worn or loose or in summer an oil of viscosity of 100 seconds at 210° F. should be used.

CHIPPERS

Blocks two or four feet long from the barkers or splitters are conveyed next to the chippers which cut about 800 slices per minute 7/8 inch thick across the grain. This method is more economical than sawing chips which wastes much as saw dust, the fibres of which are too short for use. The chipper bearings are difficult to properly lubricate. The machine consists of a large steel disc, often 84 inches diameter and 4 inches thick set with knives not unlike the barker. The receiving spout is devised to introduce the logs end-wise but at an angle to secure cross grain chips. The chemical processes act more readily with cross



Courtesy of Waterville Iron Works.
Fig. 16.—A Horizontal chip screen used to insure uniform chips.

grain cut due to a ripping of the cell walls of the fibre, and the presenting of open pores.

Lubrication.

This disc weighing several tons runs about 225 R. P. M. and strikes a blow heavy enough to chip off a clean slice from the end of a

12-inch hardwood block. The friction results in a heating of the disc which is readily conducted to the bearings which consequently run hot. In addition to this temperature and the weight of the disc on the bearing, there is the shock and strain every time a knife hits a wood block. The bearings are usually plain hand lubricated, for which an oil of 100 seconds viscosity at 210° F. should be used. If grease packed a special high melting point grease is desirable. The lubrication of these bearings will be very much improved and will keep cooler by installation of a wick oiler. When the bearings, including the thrust, are fitted with wick or other automatic oiling devices an oil of viscosity about 55 seconds at 210° F. will serve.

CHIP SCREENS

These are either in the form of horizontal shake screens or rotary cylindrical screens, the object being to separate from properly sized chips, both those which are too large and too small. This is accomplished by dropping or shaking the chips first on a coarse screen which holds back those which are too large, passing all smaller chips to the second screen which, in turn, holds those of proper size and passes those too finely divided. The digesting process requires uniform chips otherwise some will be overcooked and others not enough.

Lubrication.

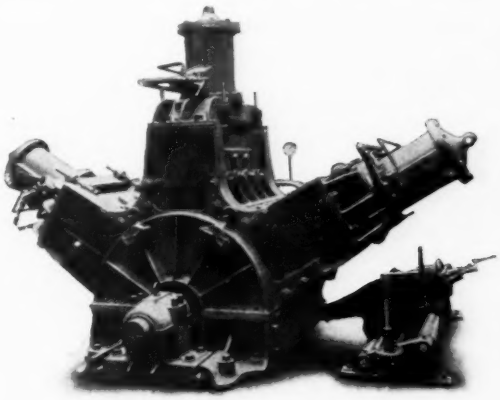
The horizontal screens are shaken by eccentrics which are lubricated usually by compression grease cups with a medium bodied grease. Other bearings can be readily lubricated by hand with an oil of 400-500 seconds viscosity at 100° F.; when bearings are close fitting and automatically oiled a viscosity of 200 seconds is satisfactory.

The rotary chip screens are usually supported on rollers whose bearings can be lubricated with an oil of 300 seconds viscosity when automatically oiled and about 500 seconds when bearings are worn or hand oiled.

CRUSHERS AND RE-CHIPPERS

The purpose of a crusher is to take the large chips and splinters discarded by the chip screens and reduce them to the required size. It consists primarily of two parts—the rotor to which are attached a series of swinging hammers; and the casing or fixed part to which are attached another series of fixed pieces of steel or fingers. The outer ends of the swinging hammers, as they revolve, pass between the fingers of the fixed casing, catching the chip between the under side of the hammers and the top side of the fingers effectively crushing it.

The re-chippers consist of a rotating element carrying a set of knives, which as they pass the stationary knives set in the frame more effectively chip the material than will the crushers and are used when the character of the wood is such that a large percentage of chips are rejected by the screens. Chips of uniform



Courtesy of Am. Voith Contact Co.

Fig. 17.—Pocket Type Grinder for making Ground Wood Pulp.

size thus produced are directly conveyed to the digesters in the chemical pulp mill.

Lubrication.

Both of these machines operate at high speed —the crusher sometimes as high as 3000 R. P. M. Both machines usually are hand oiled. An oil of about 700 seconds should be used on crusher bearings and about 950 seconds viscosity for re-chipper bearings. When bearings are close fitting and automatically oiled an oil of viscosity of 300 seconds should be used for the crusher and 400-500 seconds viscosity at 100° F. for the re-chipper. When bearings are grease lubricated a special hard high melting point grease should be used.

WOOD PULP MANUFACTURE

Mechanical Pulp.

The blocks of wood coming from the barkers and intended for mechanical pulp are conveyed directly to the grinders for conversion to pulp, which is customarily used as it comes out of the machine without bleaching and usually only with the admixture of a maximum of 20% of sulphite pulp on account of its longer fibres which add strength to the groundwood pulp.

GRINDERS

The most modern grinder satisfactory on a large scale is the magazine type, some of which have capacity of 20 cords per day. This is a vertical chamber into the top of which the

wood blocks are conveyed. At the bottom of the chamber is a revolving cylindrical coarse grindstone against which the logs are hydraulicly pressed. The grinding process is always done in the presence of much water, otherwise the pulp would spring into flames, besides the fibres shred better when wet and water is desirable to carry away the pulp. In the pocket type of grinder, a hydraulic ram presses the logs end on to the grindstone which is usually 54 inches in diameter and driven by water wheel or electric motor. The quality of pulp depends on the grit of the stone and pressure of the block against it. Another type is the caterpillar magazine grinder, whose caterpillar chains are equipped with dogs which continually force a compact column of logs against the grindstone. The wet ground wood pulp is next pumped through bull and sliver screens to remove lumps of fibres and knots and slivers.

Lubrication.

Grinder bearings are among the most difficult to lubricate in the industry. Besides the heavy pressure from the enormous weight of the grindstone there is the added pressure in forcing the wood blocks against it.

Furthermore, few grinder bearings are guarded against the entrance of water which makes lubrication even more difficult. As a result these bearings usually run warm even when water jacketed. So much trouble has been experienced that lignum vitae bearings lubricated with water are often installed to replace metal bearings. Plain bearings lubricated by hand should be adapted for wick feed oilers, the amount of oil delivered being easily controlled by the number of wicks. Lubrication can be much improved by fitting a guard on the shaft for the purpose of throwing off water by centrifugal force before reaching the bearings.

Close fitting bearings automatically lubricated when protected from water require a straight mineral oil of about 55 seconds viscosity at 210° F.; and if bearings are only partially protected an oil compounded to meet water conditions should be used.

Loose or worn bearings automatically lubricated and hand oiled bearings if water protected should be lubricated with a straight mineral oil of about 80 seconds viscosity at 210° F. and a compounded oil to meet water conditions when unprotected.

When bearing caps are provided with pockets for grease packing a hard high melting point waterproof grease should be employed, though again wick feed oilers could be installed with saving in lubrication cost, labor cost and bearing metal as well as lower power consumption.

SLIVER AND PULP SCREENS

Ground wood pulp from the grinders passes either through the perforated plates of a flat sliver screen or the wire mesh of rotary sliver screen to remove the knots, slivers and bull chips.

Rotary sliver screens are slowly revolving cylinders of wire mesh usually agitated by an eccentric and sometimes containing a paddle rapidly revolving within the cylinder.

The rejected larger slivers are sent through a sliver grinder before rejoining the screened stock which is pumped either to centrifugal or diaphragm pulp screens.

Centrifugal pulp screens may be either vertical or horizontal consisting of a casing in which there is a pocket separated from the impeller by a strainer or screen through which only the finer particles can pass.

Diaphragm pulp screens are flat boxes fitted with metal plates provided with slits narrow enough to properly strain the stock. To prevent plugging, the box is agitated by vertical rods or "trotters" operated by cams set out of step—a rubber diaphragm placed beneath the strainer produces alternately a suction and compressive force due to the up and down motion imparted by the rods.

Lubrication.

If bearings are automatically lubricated and close fitting, an oil with a viscosity of about 300 seconds at 100° F. will serve the purpose. If the bearings are worn or hand oiled, an oil of about 500 seconds at 100° F. will be required. The eccentrics are best lubricated with an oil of 500 seconds viscosity at 100° F., unless provided with grease cups for which a grease of medium consistency should be used. Trotter cams, gears, chains and sprockets require the hot application of an adhesive lubricant as described under heading of gears, chains and wire rope.

STOCK PUMPS

Slow speed fan or plunger type pumps are used to handle the pulp stock. The former derives its suction and forcing power from the rotation of a fan whose centrifugal action throws the stock from the center inlet to the discharge at the outer edge of the casing.

Lubrication.

Fan pump bearings are usually ring oiled for which an oil of 200 seconds viscosity is suitable. If the bearings are worn, or if hand oiled, a viscosity of 300 seconds should be employed. Geared plunger pumps are usually lubricated by compression grease cups, bottle or hand oiling. An oil of viscosity of 300 seconds viscosity at 100° F.

should be used for self-oilers and 500 seconds, for hand oiling; a medium cup grease in the grease cups and a fairly heavy adhesive gear lubricant for such gears as are involved.

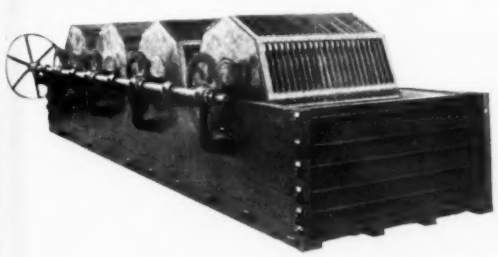
PULP THICKENER AND WET MACHINES

Wood pulp, as it comes from the screens, has too much water for treatment in the beaters; and it is therefore next passed through a pulp thickener. This is usually a cylindrical wire cage revolving in a vat of pulp stock, the upper half being above the level of the mixture. As it revolves water passes through to the inside leaving a layer of pulp which is picked off the cylinder by a couch roll revolving in opposite direction to and in contact with the cylinder. The fibre is scraped by a "doctor" from the surface of the couch roll, and in some cases where there is no couch, from the cylinder itself, after which it is conveyed directly to the stock chest.

The "wet machine" is utilized for preparing pulp for storage or shipment delivering a thick sheet of comparatively dry pulp which needs only to be put bodily into the beaters for preparation for paper. As in the thickener, the pulp is passed onto a couch roll from which it passes to a felt belt between the press rolls to squeeze out additional water. It is then wound on a roll in layers until the desired thickness is obtained, after which it is cut off and folded into sheets or laps of pulp about 18 x 24 inches in size. When shipment is to be made, these laps are passed through a mechanical or hydraulic baling press.

Lubrication.

Machines of the above type are constantly splashing water and the bearings being rarely



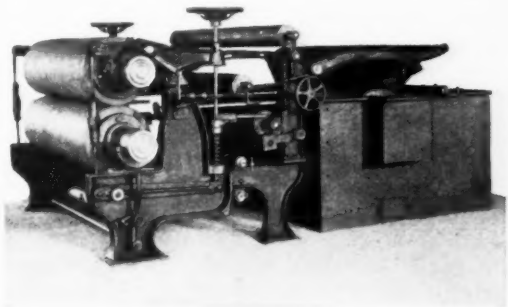
Courtesy of Downingtown Mfg. Co.

Fig. 18.—Pulp Thickener or Washer.

protected, should be lubricated with an oil properly compounded with a fatty oil to meet this condition, and a viscosity of about 700 seconds at 100° F. When grease cups are installed or plain bearings contain grease pockets in the housings, a grease prepared to meet water conditions should be used.

CHEMICAL WOOD PULP

The three chemical wood pulp processes—sulphite, soda and sulphate—present no lubrication problems not met with elsewhere in the mill with the exception of:



Courtesy of Downingtown Mfg. Co.

Fig. 19.—A typical Wet Machine.

Sulphur Conveyors.

Particular attention should be given to thorough and frequent application of the lubricants recommended previously under the heading of Conveyors. The film of a lubricant, if properly kept in place, minimizes the destructive and corrosive action of sulphuric acid.

Sulphur Burners and Calciners.

The rotary sulphur burners used in the sulphite process, and the calciners or rotary kilns used in the recovery of waste products in the soda and sulphate processes are operated by pinions and girth gears, which often become quite hot. The gears of the burners and calciners, as well as pulleys and chains used to open and close the doors of stationary burners, should frequently be coated with an adhesive and exceedingly viscous compound, which will stick and not drop off the hot gears. This oil will result in positive protection from sulphuric acid, and lubrication at the highest temperatures encountered. A straight run mineral oil with a viscosity of 2000-5000 seconds Saybolt, at 210° F. should be heated to fluidity and applied hot with a brush, the bearing surfaces having been previously well cleaned.

After the prepared wood chips are cooked or digested in the various chemical processes, the fibrous pulpy material is blown into a pit, drained of the liquor, washed with water, run through a bleach process, strained through screens similar to those described under mechanical pulp to remove knots and lumps, and finally run through the pulp thickener or

wet machines as in the case of ground wood pulp.

BLEACHING ENGINES

Chemical pulp is bleached in a Hollander similar to that used for paper stock preparation, or in a Bellmer Engine which is a much larger tub provided with an agitator on the order of a screw propeller and most recently, the Wolf Bleacher which is a round tank capable of handling pulp as much as 15% dry. In the latter type, the screw impeller is external and of much higher power.

Lubrication

These bearings should be lubricated with an oil of 300 seconds viscosity unless worn or hand oiled, when a viscosity of 500 seconds is preferable. Lubrication of Hollander and Beater types are thoroughly discussed in LUBRICATION for November 1924.

RAG, STRAW AND WASTE PAPER CONVERSION

Rags must be sorted, cut, dusted and shredded before being cooked with milk of lime or caustic soda in the huge cylindrical boiler which reduces the mass to pulp. Straw also is digested in either spherical, vomiting or cylindrical boilers, all of which are slowly revolved by pinion and girth gears.

Lubrication

The bearings of the rag machines should be lubricated with an oil of viscosity of about 200 seconds unless worn or loose or hand-oiled, when a viscosity of 500 seconds is required.

The boilers often weigh 9,000 pounds and contain 9,000 pounds of rags, producing considerable pressure on bearings which operate at high temperatures on account steam required in the process.

Therefore, even in the newest types with ring oiled bearings, an oil of viscosity at least 500 seconds should be used and a steam cylinder oil under all other conditions, including the steam joints. If grease lubricated, a hard special high melting point grease is required. If the steam joints are provided with grease cups, a special grease prepared with a heavy bodied oil should be used.

Waste paper, old newspapers, catalogs, telephone directories, etc., as well as "broke" or spoiled paper resulting from tearing during manufacture on the paper machine can be used over again to make paper.

It is only necessary to defelt the fibres which can be accomplished by pulping engines, beaters and boilers.

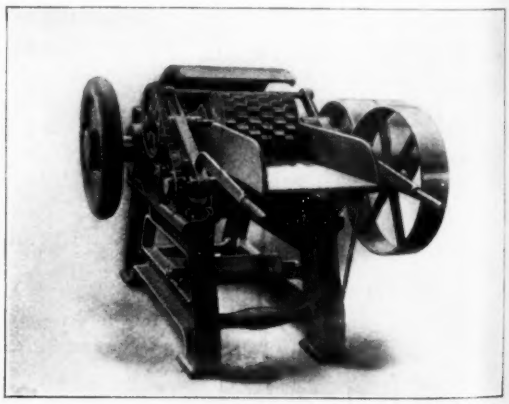
One special machine used only for this purpose is becoming more frequently used—the pulping engine. This is designed to defibre the paper without undue additional shortening of the fibres which have already undergone the cutting action of the beaters when originally manufactured into paper.

This machine consists of a tub like that of a beater containing a whipper and a propeller. The paper and water mixture is moved by the propeller towards the whipper spiders revolving at high speed which tears rather than cuts the paper. Tearing is accomplished by opposing forces, one of which is the blow of the whipper arm and the other the inertia of the paper aided by the inertia of the fluid medium in which it is suspended. The wet paper due to its inertia is unable to take up the speed of the whipper arms soon enough to avoid being torn apart. The bearings of these machines are best lubricated with a straight run mineral oil of about 300 seconds viscosity at 010 deg. F., unless the bearings are worn or hand-oiled when an oil of 500 seconds viscosity at 100° F. should be employed.

CONCLUSION

Up to this point we have considered only the lubrication in the machinery used in making pulp. In the following issue of LUBRICATION we will discuss the equipment required in the preparation of paper stock and its conversion to paper.

In the actual making of paper from pulp we meet the most important and difficult lubrication problems in the entire paper industry.



Courtesy of Noble & Wood Machine Co.

Fig. 20.—A Rag Cutter. This is the first step in reducing rags to Pulp.

A careful study of the subject will therefore repay the time it takes, in lowered lubrication and maintenance costs, and will pay dividends in money saved.

Printed in U. S. A. by
EDGAR C. RUWE CO., INC.
47 West Street, N. Y. C.

JAN 12 1925

Volume 10 November, 1924 *Number 11*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication in the Paper Industry

Conversion of Pulp to Paper

PART II

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS IN THE PULP AND PAPER MILLS

A survey and recommendations for the more widely used machinery from the log to the finished product

GENERAL CONDITIONS

A—Gears, chains, sprockets, wire rope, conveyors, and caterpillar Tractor, link pins and rollers		Texaco Crater Compound No. 1 or No. 2 (Applied hot with brush)
	If water splashed	Texaco Crater Compound X
B—Ball and Roller Bearings;	*Oil tight cases*	Texaco Texol B
	Cases not oil tight	Texaco Liquid Greases or Texaco Star Grease No. 1
C—Grease cups or nipples		Texaco Grease No. 1 or No. 3
	Heat conditions	Texaco Marfak Compound
D—Grease packed plain bearings;		
	1. *Low or medium temperatures and pressures*	Texaco Grease No. 3
	2. *High temperatures and pressures*	Texaco Hytex Grease No. 5
	Drip proof bearings	Texaco Marfak Compound
	3. *If water splashed*	Texaco Star or Hytex Grease

TIMBER OPERATIONS

STEAM CYLINDER LUBRICATION

Steam Donkey Engines, Steam Hoists and Skidders, Steam Tractors, Steam Whirley, Steam Cranes, Steam Shovels, Steam Road Building Equipment	*Dry Steam or Saturated Steam over 150 lbs.*	Texaco 650 T Cylinder Oil or Texaco Leader Cylinder Oil
	Saturated Steam, 100-150 lbs.	Texaco Pinnacle Cylinder Oil
	Wet Steam	Texaco Draco Cylinder Oil or Texaco Olympian Cylinder Oil
Steam Geared Locomotives	*Super Heat Steam*	Texaco No. 635 Valve Oil or Texaco, 650 T. Cylinder Oil
Steam Slide Rod Locomotives	*Saturated Steam over 150 lbs.*	Texaco Railroad Valve Oil or Texaco Pinnacle Cylinder Oil

BEARINGS AND OTHER MOVING PARTS OF PRIME MOVERS	*Close Fitting Bearings Lubricated by Automatic Oiling Devices*	*Worn or Loose Bearings Automatically Lubricated or Hand Oiled Bearings*
Miscellaneous Engine Parts	Texaco Texol D or Texaco Altair Oil	Texaco Texol X or Texaco Pelican Oil
Miscellaneous Machine Bearings	Texaco Texol C or Texaco Aleph Oil	Texaco Texol D or Texaco Altair Oil
Miscellaneous Machine Slides	Texaco Texol D or Texaco Altair Oil	Texaco Texol X or Texaco Pelican Oil
High Pressures	Texaco Liquid Grease D or Star Grease No. 00	Texaco Liquid Grease D or Star Grease No. 00
Journal Boxes	Texaco Car Oils Texaco Black Oils	Texaco Car Oils Texaco Black Oils
	Air Temperatures Below 10° F.	*Air Temperatures Above 10° F.*
Gasoline or Kerosene Tractors	Texaco Motor Oil, Heavy	Texaco Tractoil (Proper Grade)
Trucks	Texaco Motor Oil, Medium	TexacoMotorOil(ProperGrade)
Gasoline Hoists	Texaco Motor Oil, Medium	Texaco Motor Oil Heavy or, Extra Heavy

SAW MILL AND WOOD ROOM

	Close Fitting Bearings Lubricated by Automatic Oiling Devices	*Worn or Loose Bearings Automatically Lubricated or Hand Oiled Bearings*
SAW MILL		
Jack Ladders, Log Conveyors, Log Stackers	Texaco Texol C or Texaco Aleph oil	Texaco Texol X or Texaco Pelican Oil or Texaco Dolphin Oil
Slasher and Swing Saws	Texaco Texol B or Texaco Nabob Oil	Texaco Texol D or Texaco Altair Oil
Live Rolls, Kickers and Niggers	Texaco Texol X or Texaco Pelican Oil	Texaco Thuban Compound or Texaco Crater Compound No.1
Steam Cylinders	Texaco Pinnacle Cylinder Oil	
WOOD ROOM		
Drum Barkers	Texaco Texol C or Texaco Aleph Oil	Texaco Dolphin Oil
Disc Barkers	Texaco Texol B or Texaco Nabob Oil	Texaco Texol D or Texaco Altair Oil

	Close Fitting Bearings Lubricated by Automatic Oiling Devices	*Worn or Loose Bearings Automatically Lubricated or Hand Oiled Bearings*
Splitters		
Bearings	Texaco Texol B or Texaco Nabob Oil	Texaco Texol C or Texaco Aleph Oil
Guides	Texaco Texol X or Texaco Pelican Oil	Texaco Cylinder Oils
Chippers	Texaco Texol D or Texaco Altair Oil	Texaco Cylinder Oils**
Horizontal Chip Screen	Texaco Texol B or Texaco Nabob Oil	Texaco Texol D or Texaco Altair Oil
Rotary Chip Screen, Chip Belt Conveyor	Texaco Texol C or Texaco Aleph Oil	Texaco Texol E or Texaco Altair Oil
Chip Crushers	Texaco Texol C or Texaco Aleph Oil	Texaco Texol X or Texaco Pelican Oil
Re-Chippers	Texaco Texol D or Texaco Altair Oil	Texaco Cylinder Oils**

**When too heavy for Wick or Ring Oilers, use Texaco Texol X.

***When too heavy for Wick or Ring Oilers, use Texaco Draco Cylinder Oil.